

What is claimed is:

SJA37 1. A well tool for selectively sealing areas within a well tubular comprising:

5 a first axially extending plug adapted to be axially movable within an axially extending well tubular for isolating fluids in first and second areas within said well tubular on either axial end of said first plug,

a first outer seal for providing a sliding, sealing engagement between said first plug and an internal surface of said well tubular,

an axially extending mandrel extending through said first plug,

10 a mandrel flow passage extending axially through said mandrel,

a first inner seal for providing a sliding, sealing engagement between said first plug and said mandrel,

a first port extending from said flow passage of said mandrel to said first area,

15 a first movable closure member movable between a closed and an open position for respectively closing said first port when in said closed position or opening said first port when in said open position whereby said first closure member respectively blocks or permits pressure communications between said mandrel flow passage and said first area,

20 a first closure mechanism for moving said first closure member from said closed to said open position, and

a first release mechanism responsive to movement of said first closure mechanism for permitting said first plug to be displaced axially free of said

Sub A3
mandrel in response to a pressure differential between said first area and said second area.

2. A well tool as defined in claim 1 further comprising:

5 a first one-way valve for sealing a central opening through said first plug when said first plug is displaced from said mandrel whereby said first plug forms a seal within said well tubular for isolating said first and second pressure areas.

3. A well tool as defined in claim 2 further comprising a releasable
10 seal carried by said first plug, said releasable seal being selectively operable to provide pressure communication between said first and second areas.

4. A well tool as defined in claim 1 wherein, when displaced from said
15 mandrel, said first plug is a body having a major percentage of its composition being a nonmetallic material.

5. A well tool as defined in claim 1 wherein said mandrel is retrievable through said well tubular following displacement of said first plug.

20 6. A well tool as defined in claim 2 further comprising a second axially extending plug adapted to be axially movable within said well tubular for isolating fluids in third and fourth areas within said well tubular on either axial end of said second plug, said second plug disposed about said mandrel,

SUBA3)

a second outer seal for providing a sliding, sealing engagement between said second plug and an internal surface of said well tubular,

a second inner seal for providing a sliding, sealing engagement between said second plug and said mandrel,

5 a second port extending from said flow passage of said mandrel to said third area,

a second movable closure member movable between a closed and an opened position for respectively closing said second port when in said closed position or opening said second port when in said open position whereby said
10 second closure member respectively blocks or permits pressure communication between said mandrel flow passage and said third area,

a second closure mechanism for moving said second closure member from said closed to said opened position, and

a second release mechanism responsive to movement of said second
15 closure mechanism for permitting said second plug to be displaced axially free of said mandrel in response to a pressure differential between said third area and said fourth area.

7. A well tool as defined in claim 6 further comprising:

20 a second one-way valve for sealing a central opening through said second plug when said second plug is displaced from said mandrel whereby said second plug forms a seal within said well tubular for isolating said third and fourth pressure areas.

4003711.1.030102

Sub B

8. A well tool as defined in claim 1 wherein said first closure mechanism includes a first flow closure device that seals said mandrel flow passage to seal said first area from said second area whereby a pressure differential acting across said first closure mechanism moves said first release mechanism.

9. A well tool as defined in claim 8 wherein said first flow closure device comprises a ball.

10. A well tool as defined in claim 8 wherein said first flow closure device comprises a dart.

11. A well surface operated system for remotely deploying wiper plugs into a well casing comprising:

a running tool having an axially extending tubular mandrel, said mandrel having an axially extending flow passage for conducting fluid axially through said well casing,

a first plug carried by said mandrel, said first plug having an outside sealing diameter for sealing with an internal surface of said well casing and further having an axially extending flow passage cooperating with said axially extending flow passage of said running tool for conducting fluids axially through said well casing,

40067217.030402

Sub A37

a first release mechanism carried by said mandrel, said first release mechanism being operable from a well surface with a release mechanism actuator to actuate said first release mechanism to release said first plug from said mandrel, and

5 a first flow passage closure device, separate from said release mechanism actuator, carried by said first plug, said first flow passage closure device being operable when said first plug is released from said mandrel to seal said flow passage extending through said first plug.

10 12. A remotely operated system as defined in claim 11 further comprising:

a second wiper plug carried by said mandrel, said second wiper plug having an outside sealing diameter for sealing with said internal surface of said well casing and further having an axially extending flow passage cooperating
15 with said axially extending flow passage of said mandrel for conducting fluids axially through said well casing,

a second release mechanism carried by said mandrel, said second release mechanism being operable from the well surface with a second release mechanism actuator to actuate said second release mechanism to release said
20 second plug from said mandrel, and

a second flow passage closure device, separate from said second release mechanism actuator, carried by said second plug, said second flow passage

40067543-030402

Sub A37
closure device being operable when said second plug is released from said mandrel to seal said flow passage extending through said second plug.

13. A remotely operated system as defined in claim 11 wherein said
5 mandrel and said release mechanism and said release mechanism actuator are retrievable to the well surface with said running tool after said first plug is released from said mandrel.

14. A remotely operated system as defined in claim 12 wherein said
10 mandrel and said release mechanisms and said release mechanism actuators are retrievable to the well surface with said running tool after said first and second plugs are released from said mandrel.

15. A remotely operated system as defined in claim 11 wherein said
15 flow passage closure device comprises a flapper valve gate carried by said first plug.

16. A remotely operated system as defined in claim 11 wherein,
said first plug includes a sealing surface seat extending about said first
20 plug flow passage and said first flow passage closure device includes a first sealing component adapted to engage and seal with said first sealing surface seat to close said wiper plug flow passage, and

400675430102

Sub B37

wherein said first sealing surface seat and said first sealing component are protected from erosion when said first plug is carried by said mandrel.

17. A remotely operated system as defined in claim 12 wherein said
5 plugs are respectively provided with sealing surfaces on passage closure
devices that meet to respectively close the flow passages through said plugs
when said plugs are released from said mandrel, and

wherein said sealing surfaces are protected from erosion caused by fluids
flowing through said well casing before said plugs are released from said
10 mandrel.

18. A remotely operated system as defined in claim 11 wherein said
first release mechanism comprises an axially extending sleeve carried coaxially
within said running tool and wherein said sleeve is movable axially by said
15 release mechanism to release said plug from said mandrel.

19. A remotely operated system as defined in claim 11 wherein said
first release mechanism and said release mechanism actuator cooperate with
said running tool to isolate a first area in said well casing on one axial end of said
20 first plug from a second area in said well casing at a second axial end of said first
plug whereby pressure applied at said first axial end is effective on said first plug
across a cross-sectional area substantially equal to the cross-sectional area of
said first plug for producing a pressure induced axial force tending to move said

40067343-030102

Sub A3
first plug axially through said well casing when said first plug is mounted on said mandrel.

20. A remotely operated system as defined in claim 19 wherein said
5 release mechanism comprises a sleeve coaxially carried by said mandrel and
said release mechanism actuator comprises a ball or dart introduced into said
running tool from said well surface whereby said actuator engages and seals
with said sleeve and whereby pressure applied from the well surface through
said running tool shifts said sleeve axially to release said first plug and to open a
10 lateral flow passage through said mandrel communicating said mandrel flow
passage with said first area in said well casing.

21. A remotely operated system as defined in claim 11 further
comprising multiple plugs having substantially similar dimensions carried on said
15 mandrel and adapted to be sequentially released from said mandrel.

22. A remotely operated system as defined in claim 21 wherein at least
one of said plugs includes a flow passage reopening device for reopening the
flow passage through said one plug after said one plug is released from said
20 mandrel.

23. A remotely operated system as defined in claim 11 wherein said
wiper plug is constructed substantially from non-metallic components.

4006741.1, 030402

Sub A37

24. A remotely operated system as defined in claim 11 wherein said running tool has sufficient axial development to receive a release mechanism activator comprising a ball or a dart.

5

25. A remotely operated system as defined in claim 21 wherein release of one of said multiple plugs from said mandrel is effected without the application of release forces to another of said multiple plugs on said mandrel.

10

26. A remotely operated system as defined in claim 14 wherein said flow passage closure devices comprise flapper gates carried by said first and second plugs.

15

27. A remotely operated system as defined in claim 26 wherein said wiper plugs are provided with sealing surfaces on passage closure devices that meet to close the flow passages through said plugs when said plugs are released from said mandrel, and

wherein said sealing surfaces are protected from erosion caused by fluids flowing through said well casing before said plugs are released from said

20

mandrel.

Sub A37

28. A remotely operated system as defined in claim 27 wherein said release mechanisms comprise axially extending sleeves carried coaxially within

Sub A37
said running tool and wherein said sleeves are movable axially by said release mechanisms to release said plugs from said mandrel.

29. A remotely operated system as defined in claim 28 wherein said
5 release mechanisms comprise sleeves coaxially carried by said mandrel and
said release mechanism actuators comprise balls or darts introduced into said
running tool from said well surface whereby said actuators engage and seal with
said sleeves and whereby pressure applied from the well surface through said
running tool shifts said sleeves axially to release said plugs from said mandrel
10 and to open a lateral flow passages through said mandrel communicating said
mandrel flow passage with areas in said well casing between said well surface
and said plugs.

30. A method for releasing plugs in a well casing for cementing said
15 well casing in a wellbore comprising:

locking multiple plugs on a tubular mandrel of a running tool carried at the
end of a well conduit,

positioning said running tool and plugs within said well casing,

flowing fluid through said well conduit and through said mandrel and plugs
20 into said casing below said running tool,

inserting a release actuator mechanism into said well conduit at the well
surface.

SUBAB7

engaging said release actuator with an axially movable sleeve carried by said running tool,

applying fluid pressure from the well surface to said release actuator to move said sleeve axially through said running tool for opening a flow passage from said mandrel into said casing and unlocking one of said wiper plugs from said mandrel, and

applying fluid pressure across an area substantially equal to the full lateral cross-sectional area of said unlocked plug to produce a pressure induced force to move said unlocked plug axially for release from said mandrel.

10

31. A method as defined in claim 30 further comprising closing a flow passage through said unlocked plug after release from said mandrel whereby said plug seals said casing permitting said plug to be moved axially through said casing by fluid pressure applied from the well surface.

15

32. A method as defined in claim 31 further including protecting plug sealing surfaces formed on said plugs from erosion as fluid flows through said running tool.

20

33. A method as defined in claim 32 further comprising closing a flow passage through at least one of said plugs with a hinged flapper gate carried on said at least one wiper plug.

40067543.030402

Sub B3

34. A method as defined in claim 33 further comprising constructing substantially of non-metallic materials.

35. A method as defined in claim 30 wherein said running tool, tubular
5 mandrel and release actuator are retrieved to the well surface after said wiper
plug are unlocked and released from said mandrel.

36. An apparatus for deploying plugs used in cementing a casing string
from a well surface comprising:

10 a running tool adapted to be connected to the end of a tubular well pipe;

a thin wall, tubular mandrel in said running tool, said mandrel having a
central flow passage extending axially through said mandrel and first and second
flow passages extending laterally through said mandrel wall into said casing
string,

15 first and second plugs having first and second central flow passages,
respectively, coaxially mounted on said tubular mandrel,

first and second release sleeves coaxially mounted with said tubular
mandrel for temporarily locking said first and second plugs, respectively, to said
mandrel and for temporarily sealing, respectively, said first and second lateral
20 flow passages, and

first and second sealing members carried on said first and second plugs,
respectively, for sealing said first and second central flow passages, respectively,
when said plugs are released from said mandrel.

40067543-030102

Sub A3

37. An apparatus as defined in claim 36 wherein said first and second sealing members are disposed intermediate said tubular mandrel and said casing while said plugs are locked on said mandrel for protecting said first and
5 second sealing members from erosion caused by flow of fluids through said setting tool.

38. An apparatus as defined in claim 36 wherein said plugs are constructed substantially of non-metallic components.

10

39. An apparatus as defined in claim 36 wherein said mandrel and release sleeves are secured to and said running tool for retrieval to the surface after said plugs are released from said mandrel.

15

40. An apparatus as defined in claim 36 wherein said first and second release sleeves include internal pass-through openings and said pass-through opening of said first release sleeve is larger than said pass-through opening of said second release sleeve.

1008733.030102